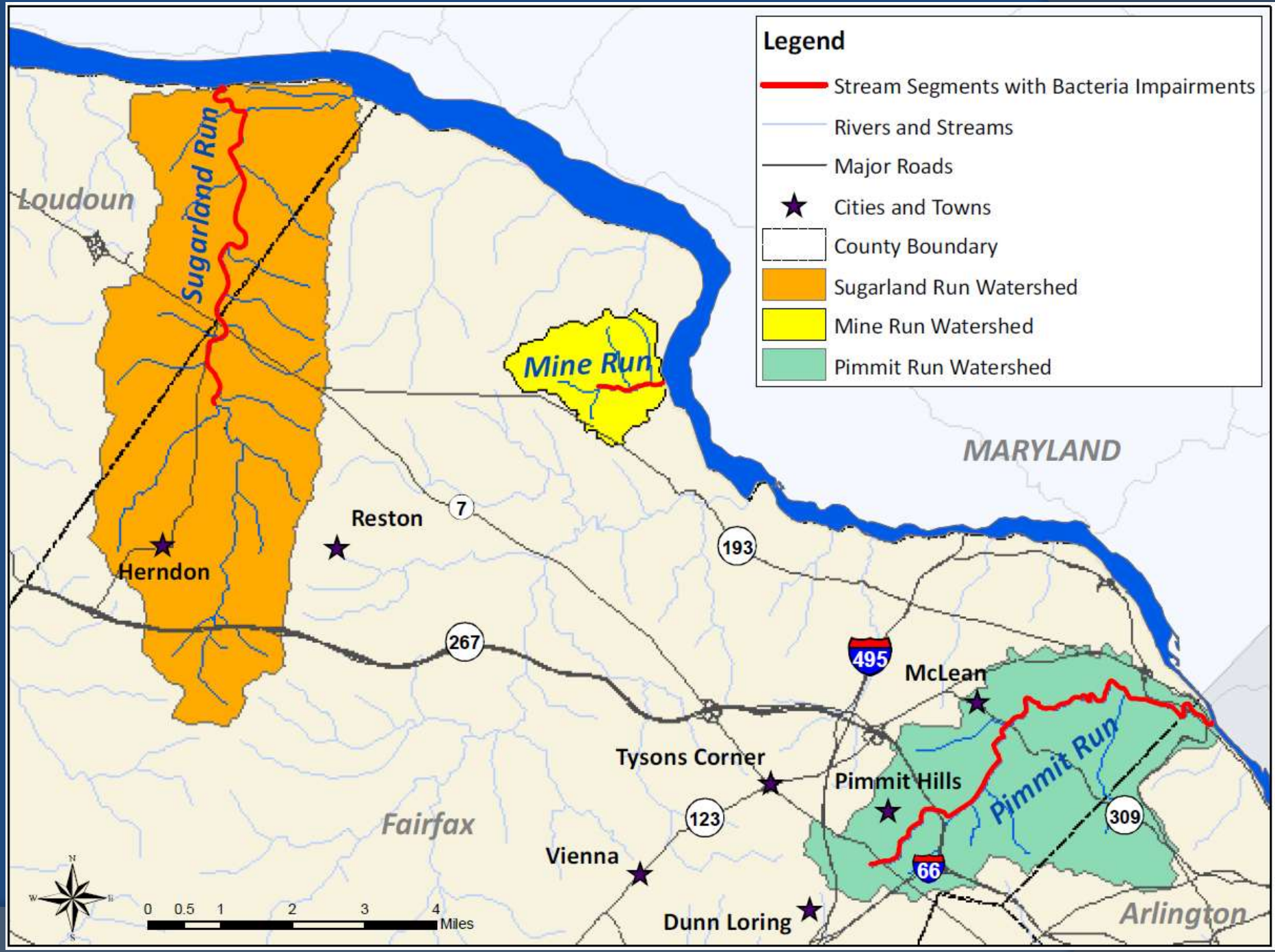
Bacteria Total Maximum Daily Load Studies for Sugarland Run, Mine Run, and Pimmit Run



Technical Advisory Committee Meeting #2
September 14, 2011

Meeting Agenda

- **Project Background and Updates** (*DEQ*)
- **Technical Approach** (*Louis Berger Group and DEQ*)
  - **Land Use**
  - **Source Assessment**
  - **Modeling Framework**
  - **Other Issues**
- **Next Steps** (*DEQ*)
- **Questions**


Legend
Stream Segments with Bacteria Impairments
Rivers and Streams
Major Roads
Cities and Towns
County Boundary
Sugarland Run Watershed
Mine Run Watershed
Pimmit Run Watershed
Sugarland Run
Mine Run
Pimmit Run
Loudoun
Fairfax
Arlington
MARYLAND
Herndon
Reston
Tysons Corner
Pimmit Hills
McLean
Vienna
Dunn Loring
7
193
267
495
123
309
66
0 0.5 1 2 3 4 Miles

Waterbody Name *Location*	**Segment Size**	**Cause**	**Upstream Limit**	**Downstream Limit**	**DEQ Monitoring Station(s)** *Station Location*	**Year First Listed as Impaired**	**2010 Exceedance Rate**
Sugarland Run *Fairfax County Loudoun County Town of Herndon*	0.95 miles	*E. coli*	Confluence with Folly Lick Branch	Boundary of the PWS designation area, at rivermile 4.82	**1aSUG004.42** *Route 7 Bridge Crossing*	2006	5 of 28 samples (17.9%)
	4.77 miles	*E. coli*	Boundary of the PWS designation area, at rivermile 4.82	Confluence with the Potomac River	**1aSUG004.42** *Route 7 Bridge Crossing*	2002	5 of 28 samples (17.9%)
Mine Run *Fairfax County*	0.93 miles	*E. coli*	Confluence with an unnamed tributary to Mine Run	Confluence with the Potomac River	**1aMNR000.72** Route 603 Bridge Crossing	2006	3 of 12 samples (25.0%)
Pimmit Run *Arlington County Fairfax County*	1.62 miles	*E. coli*	Confluence with Little Pimmit Run	Confluence with the Potomac River	**1aPIM000.15** *Route 120 (Glebe Road) Bridge Crossing*	2010*	3 of 11 samples (27.3%)
	2.46 miles	*E. coli*	Route 309 bridge crossing	Confluence with Little Pimmit Run	**1aPIM001.89** *Ranleigh Road Bridge Crossing*	2010*	3 of 14 samples (21.4%)
	3.29 miles	*E. coli*	Headwaters of Pimmit Run	Route 309 bridge crossing	**1aPIM004.16** *Route 309 Bridge Crossing*	2010*	4 of 10 samples (40.0%)

** Pimmit Run was originally listed with a fecal coliform bacteria impairment from 2002 to 2008. 2010 was the first assessment cycle where Pimmit Run was listed as impaired for E. coli.*

Project Update

- **Public Meeting held April 13, 2011**
- **May – July: Worked on Source Assessment**
- **TAC Review of Source Assessment:**
  August 18, 2011 – September 9, 2011

Technical Approach

- Land Use
- Source Assessment
- Modeling Framework
- MS4 Permits

Land Use Comparison: Fairfax County and NLCD Land Uses

- Received land use data from Fairfax County. Data covered the portions of Sugarland Run, Mine Run, and Pimmit Run watersheds located within Fairfax County.
- NLCD 2006 Land Use covers entire TMDL Study Area
- Want to use the most up-to-date, comprehensive land use data for TMDL Development.
- Analysis performed to determine if there were significant differences in the land use layers, and to help determine which land use layer to use.

Land Use Comparison: Fairfax County and NLCD Land Uses

Reclassified Fairfax Land Use Category	Acres*	% Total	NLCD Land Use Category	Acres*	% Total
Developed, High Intensity	1,565	8.6%	Developed, High Intensity	657	3.6%
Developed, Low Intensity	11,176	61.7%	Developed, Low Intensity	4,460	24.6%
Developed, Medium Intensity	650	3.6%	Developed, Medium Intensity	1,401	7.7%
Developed, Open Space	3,575	19.7%	Developed, Open Space	3,164	17.5%
Cultivated Crops	10	0.1%	Agricultural (including Cultivated Crops)	207	1.1%
Mixed Forest	1,144	6.3%	Forest (including Mixed Forest)	7,082	39.1%
			Wetland	515	2.8%
			Open Water	34	0.2%
			Scrub/Shrub	502	2.8%
			Grassland/Herbaceous	83	0.5%
			Bare Land	14	0.1%
			Unconsolidated Shore	1	0.0%
Total	18,119	100%	Total	**18,119**	**100%**

*Acreages were calculated in NAD1983 UTM Zone 18N projection

Categories highlighted in yellow are those where the largest discrepancies between the two layers were observed.

Differences Between Fairfax County and NLCD Land Uses

- **Fairfax County data is a parcel based classification (*Each parcel has been assigned an existing land use code out of over 200 such numeric codes defined for the County).***
- **Fairfax County data does not categorize any water features such as wetlands or open water; NLCD does.**
- **Fairfax Land Use Data is from 2003; NLCD Land Use is from 2006.**
- **Fairfax County data shows more low intensity developed land areas than the NLCD data; and NLCD data shows more forested areas than the Fairfax County data.**

Fairfax County Land Use: All Low Intensity Residential

NLCD Land Use: Divided between Open Space, Forest, and Low, Medium & High Intensity Residential

Source Assessment Using the Two Datasets

Summary of Bacteria Loads* for Wildlife, Septic and Pets using NLCD 2006 and Fairfax County land use data:

Bacteria Source	Bacteria Loads [Using NLCD 2006 data] [#/day]	Bacteria Loads [Using Fairfax County data] [#/day]
Wildlife	2.36E+13	2.65E+13
Septic Systems	1.57E+09	1.60E+09
Pets	7.00E+13	7.15E+13
Total	9.36E+13	9.80E+13

*These are NOT TMDL loadings, but rather estimates used to analyze and determine whether there is a difference in bacteria loadings depending on which land use layer is used.

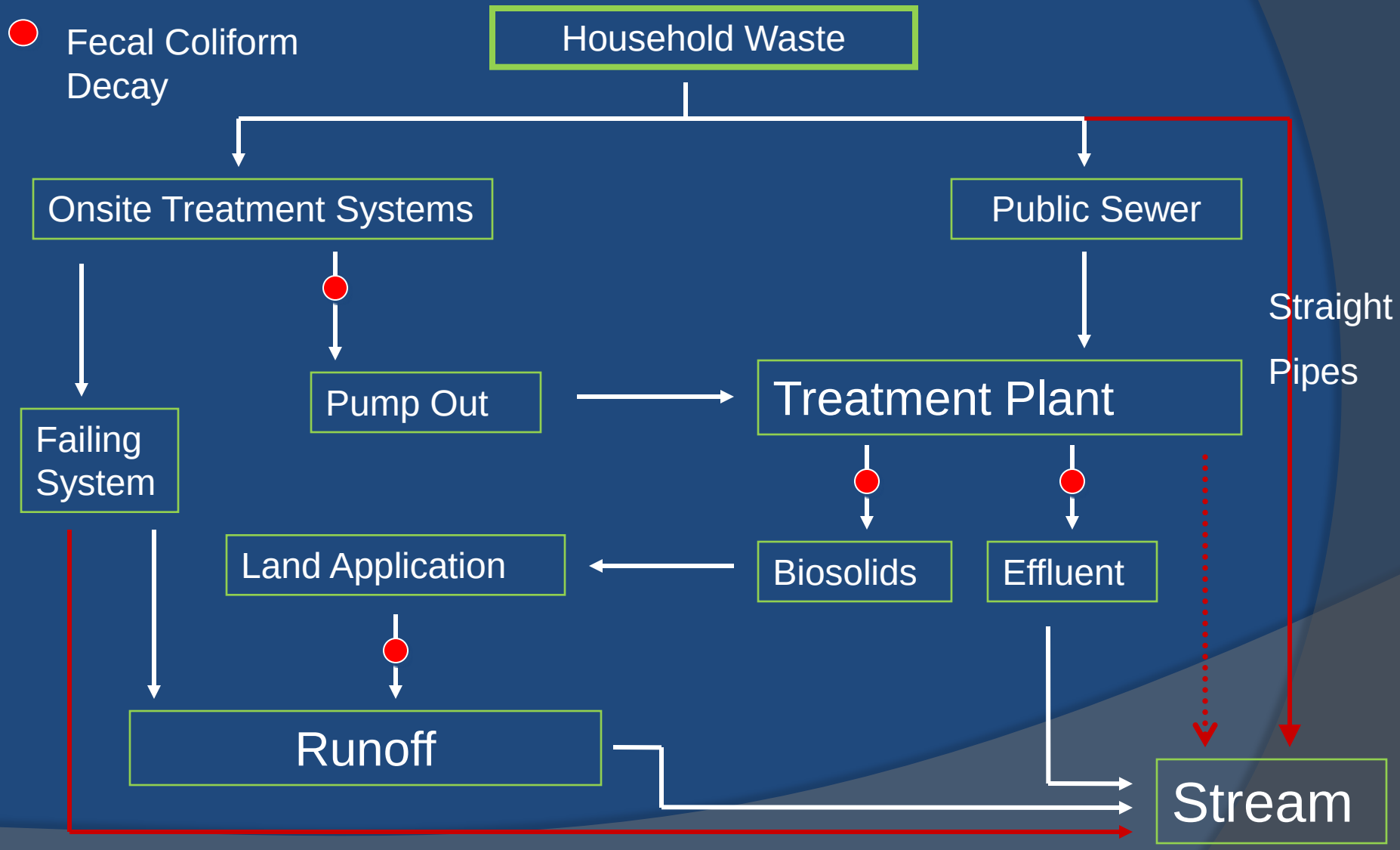
Decision: Use the NLCD 2006 Land Use Layer

- The NLCD land use provides continuity of use along different localities and jurisdictions.
- NLCD land use dataset is more recent (2006).
- There is a minimal difference in projected bacteria loads between the two land use datasets.

Bacteria Source Assessment

- Inventory of potential bacteria sources in the watershed:
  - Human
  - Wildlife
  - Livestock
  - Pets
- Data Sources:
  - Local Experts (Local Governments, TAC, SWCDs, Health Department, etc.)
  - Census Data (Agricultural Census and US Census)
  - Literature Studies

Bacteria From Human Sources



Population Estimates

- Based on 2009 United States Census Data and Stakeholder Input.
- Sewage Disposal Methods:
  - Sewer Systems (predominantly cities)
  - Septic Systems
    - Failure rates can range between 3 and 40%. 3% failure rate used for this project.
  - Other Systems (assumed to be no waste management, or “straight pipe”)
- Failing septic systems and straight pipes near stream channels can contribute significant sewage. In Sugarland Run, Mine Run and Pimmit Run watersheds:
  - Approximately 72 failing septic systems
  - Approximately 87 straight pipes discharging directly to stream

Estimates of Failing Septic Systems and Straight Pipes by Impaired Watershed

Impairment Watershed	Failing Septic Systems	Straight Pipes
Sugarland Run	45†	48
Mine Run	1	1
Pimmit Run	26‡	38

†For portion of Sugarland Run in Loudoun County, a 2% septic failure rate was provided

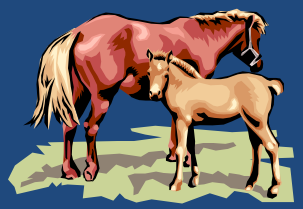
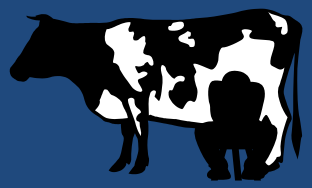
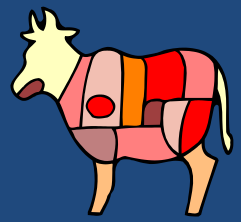
‡This number incorporates Arlington County's estimate of 8 septic systems for the portion of Pimmit Run within Arlington County

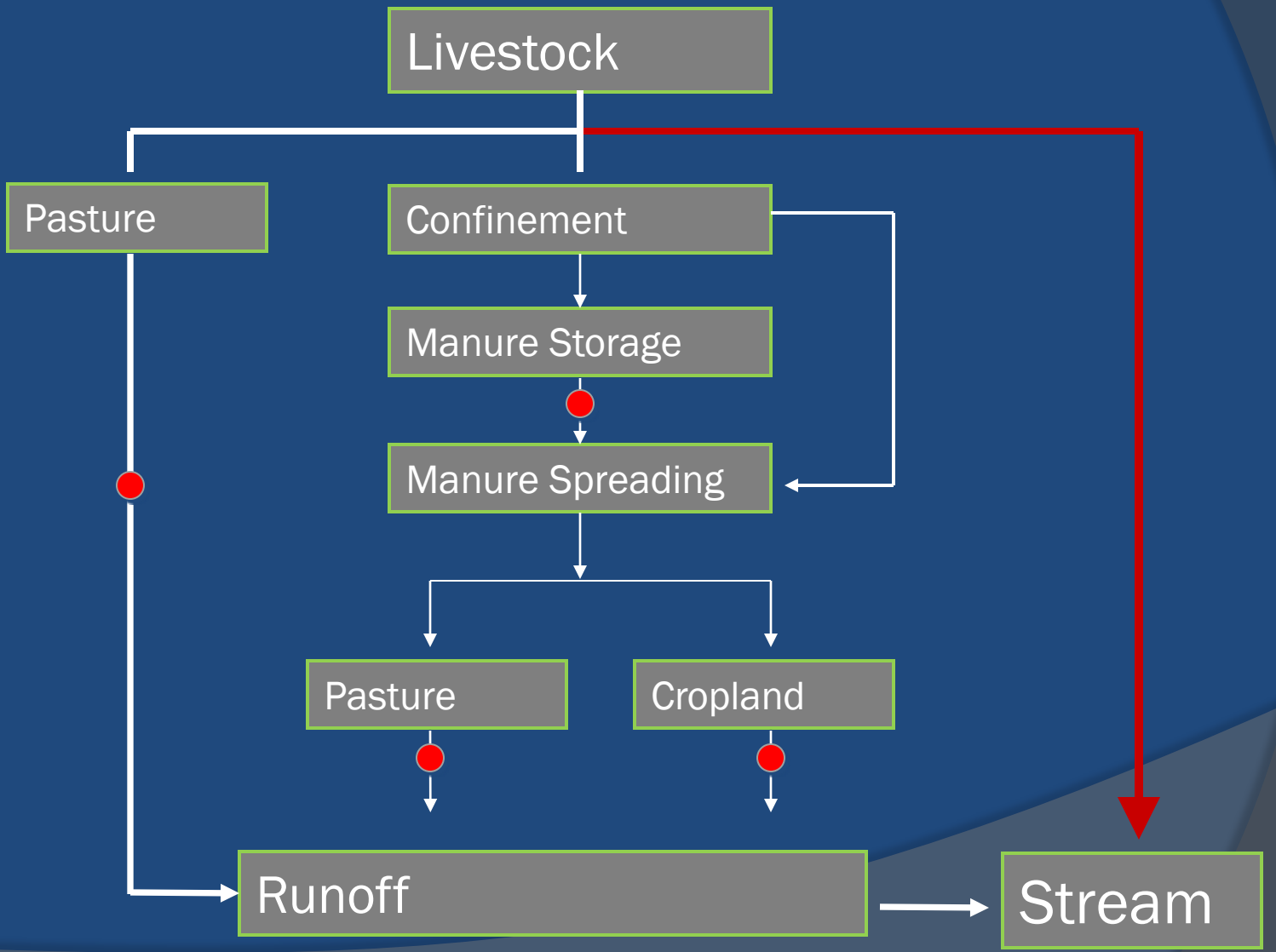
Sugarland Run, Mine Run and Pimmit Run Point Source* Inventory

Permit Number	Facility Name	Watershed	Permit Type	Maximum Design Flow (MGD)	Permit Limit for *E. coli* bacteria: (cfu/100 ml)
VAG406279	Residence	Sugarland Run	VPDES - General Domestic	0.001	126

Permit Number	MS4 Permit Holder
VA0088587	Fairfax County
VAR040104	Fairfax County Public Schools
VAR040067	Loudoun County
VAR040060	Town of Herndon
VAR040115	Virginia Department of Transportation
VAR040111	George Washington Memorial Parkway
VA0088579	Arlington County

Only permits that are expected to discharge the pollutant of concern (bacteria) are presented on this slide.


Livestock
Pasture
Confinement
Manure Storage
Manure Spreading
Pasture
Cropland
Runoff
Stream
Fecal Coliform Decay

Livestock Estimation:

- Total # of livestock and total number of pastureland acres in counties obtained from the United States Department of Agriculture (USDA) 2007 Agricultural Census*
- Total amount of pastureland in each impaired watershed calculated via GIS (NLCD 2006 land cover)
- Ratio of watershed area to county area applied to livestock #s

Example Using Hypothetical Numbers:

$$\frac{\text{Acres of Pastureland in Impaired Watershed}^{*}}{\text{Acres of Pastureland in County}^{\#}} = \frac{\text{Number of Horses in Impaired Watershed}}{\text{Number of Horses in County}^{\#}}$$

$$\frac{20 \text{ acres}}{100 \text{ acres}} = \frac{X}{50 \text{ horses}}$$

$$X = 10 \text{ horses}$$

**Obtained from NLCD Land Use GIS Layer*
 # Obtained from the 2007 Agricultural Census

**(http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp).*

Livestock Estimates* within the Study Area by County:

Livestock Type	Loudoun	Fairfax	Arlington
Beef cows	11,595	50	0
Milk cows	214	0	0
Other Cattle	8,887	0	0
Hogs and pigs inventory	137	83	0
Sheep and lambs inventory	2,410	48	0
Chickens	255	0	0
Chickens (Layers)	3,892	279	0
Turkeys	120	0	0
Horses and ponies, inventory	5,838	636	0

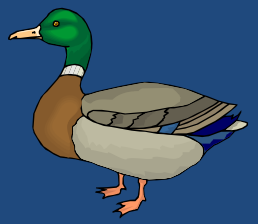
**Livestock numbers are based on the 2007 US Agricultural Census data*

Livestock Estimates by Impaired Watershed:

Livestock Animal	Sugarland Run[1]	Mine Run	Pimmit Run*
Beef Cows	11	0	0
Milk Cows	0	0	0
Other Cattle	9	0	0
Hogs & Pigs	0	0	0
Sheep & Lambs	2	0	0
Chickens	0	0	0
Chickens (Layers)	4	1	1
Turkeys	0	0	0
Horses & Ponies	0	0	0

[1] Based on input from Loudoun County and USDA 2007 Agriculture Data

* Based on USDA 2007 Agricultural Census Data (http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp)



Wildlife

Pasture

Cropland

Forest

Built-up area

Runoff

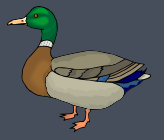
Stream

Fecal Coliform Decay

Wildlife Densities

Wildlife Type	Habitat Requirements	Animal Density per Acre of Habitat
Deer	Entire watershed	0.12 animals/acre
Raccoon	Entire watershed	0.31 animals/acre
Muskrat	Within 60 feet of streams and ponds (urban, grassland, forest, wetlands)	0.23 animals/acre
Beaver	Within 66 feet of streams and ponds	4.8 animals/acre
Goose-Summer	Within 300 feet of streams and ponds (urban, grassland, wetlands)	2.34 animals/acre
Goose-winter	Within 300 feet of streams and ponds (urban, grassland, wetlands)	2.50 animals/acre
Duck- Summer	Within 300 feet of streams and ponds (urban, grassland wetlands, forest)	0.06 animals/acre
Duck- Winter	Within 300 feet of streams and ponds (urban, grassland wetlands, forest)	0.37 animals/acre
Turkey	Entire watershed excluding urban land uses	0.01 animals/acre

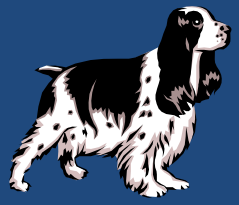
[1] Source: Difficult Run Bacteria TMDL Report (VA DEQ), Department of Game and Inland Fisheries (DGIF)



Wildlife Estimates by Impaired Watershed

Wildlife Animal	Sugarland Run	Mine Run	Pimmit Run
Deer	1,744	191	941
Raccoon	4,504	494	2,431
Muskrat	178	21	55
Beaver	4,298	530	1,281
Goose – Summer	6,354	337	1,251
Goose – Winter	6,788	360	1,336
Duck – Summer	235	29	70
Duck - Winter	1,447	177	434
Wild Turkey	37	10	26

[1] *Based on densities used in the Difficult Run Bacteria TMDL Report (VA DEQ) and provided by the Department of Game and Inland Fisheries (DGIF)*



Pets: Dogs & Cats

Pasture

Cropland

Forest

Built-up area

Runoff

Stream

Fecal Coliform Decay

Pet Estimates

- Pet Estimates:
- Pet inventories based on:
  - 0.632 Dogs per household*
  - 0.713 Cats per household*
- In the study area there are approximately:
  - 23,216 Dogs
  - 26,190 Cats

*AVMA, 2007

Pet Estimates by Impairment Watershed

Impaired Watershed	Cats	Dogs
Sugarland Run	11,083	9,824
Mine Run	1,768	1,568
Pimmit Run	13,339	11,824

Source Loading Estimates

- Determine the daily fecal coliform production by source
- Estimate the size/number of each source
- Determine whether the source is
  - Direct
  - Indirect
- Calculate the load to each land use based on a monthly schedule and for each source
- The sum of all the individual sources is the total load

Daily Fecal Coliform Production by Source

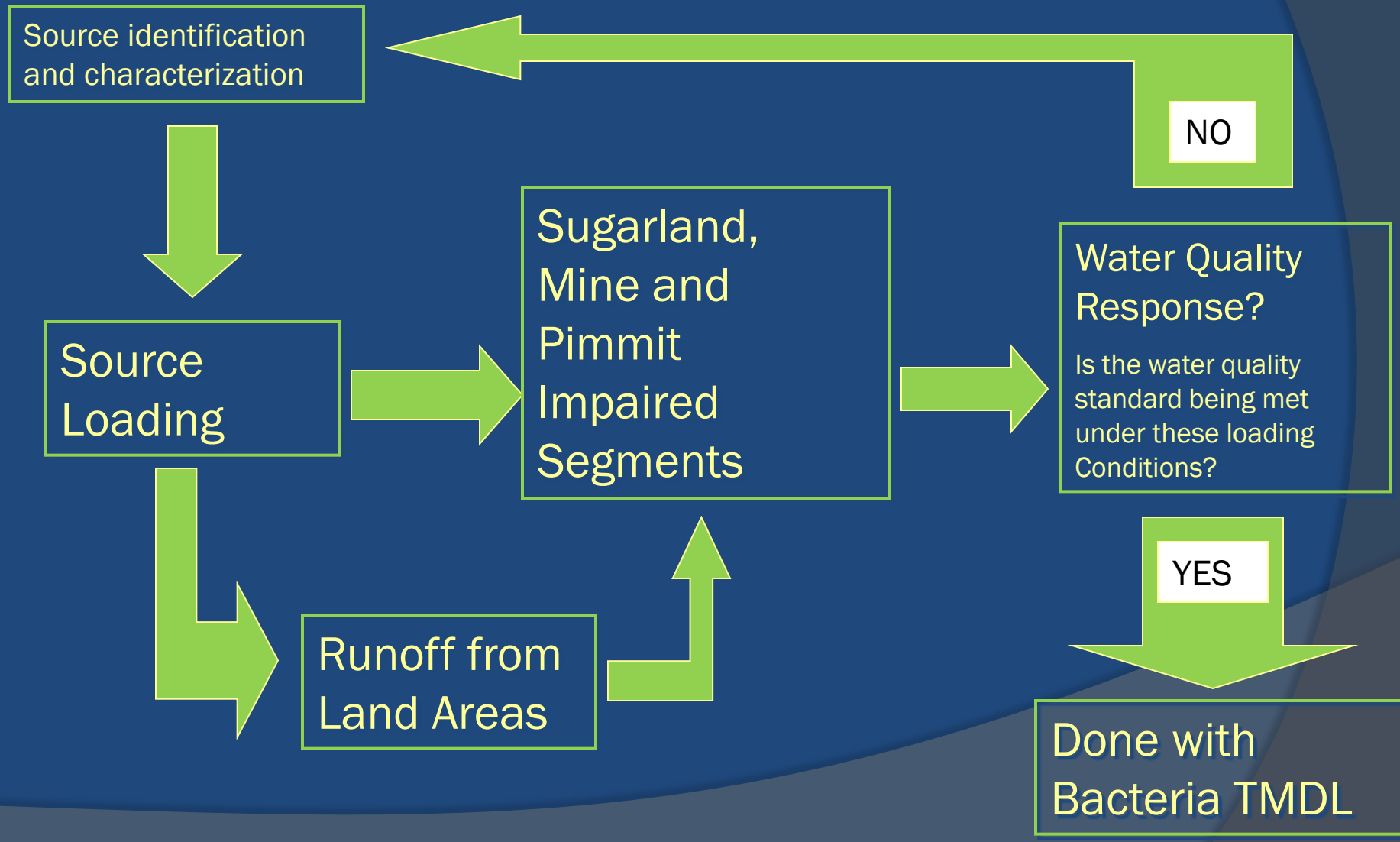
Source	Fecal Coliform Content in Fecal Matter (million) (cfu/day)
Human	1,950
Pet	450
Horse	420
Beef Cattle	33,000
Dairy-Milked or dry Cow	25,200
Dairy-Heifer	11,592
Sheep	27,000
Deer	347
Raccoon	113
Muskrat	25
Beaver	0.2
Goose	799
Duck	2,430
Mallard	2,430
Wild Turkey	93
Hog	10,800
Chicken (Layer)	136

Source	The Equivalent Number of Sources to One Beef Cow
Human	16.92
Pet	73.33
Horse	78.57
Beef Cattle	1.00
Dairy-Milked or dry Cow	1.31
Dairy-Heifer	2.85
Sheep	1.22
Deer	95.10
Raccoon	292.04
Muskrat	1,320.00
Beaver	165,000.00
Goose	41.30
Duck	13.58
Mallard	13.58
Wild Turkey	354.84
Hog	3.06
Chicken (Layer)	242.65

NOTE: The fecal coliform content is based on analysis of the fecal matter from these sources.

Sources: ASAE, Map Tech, Metcalf & Eddy,

Linking the Source to the Instream Water Quality



Water Quality Model: HSPF

Hydrologic Simulation Program Fortran

Input → Model → Output

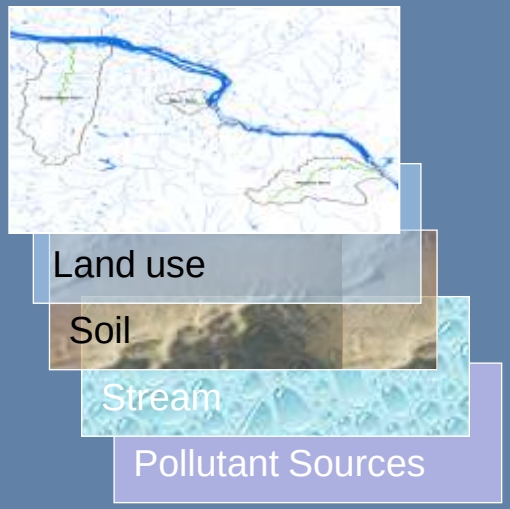
Factors:

Rainfall events

Fecal coliform build up

Fecal coliform wash off

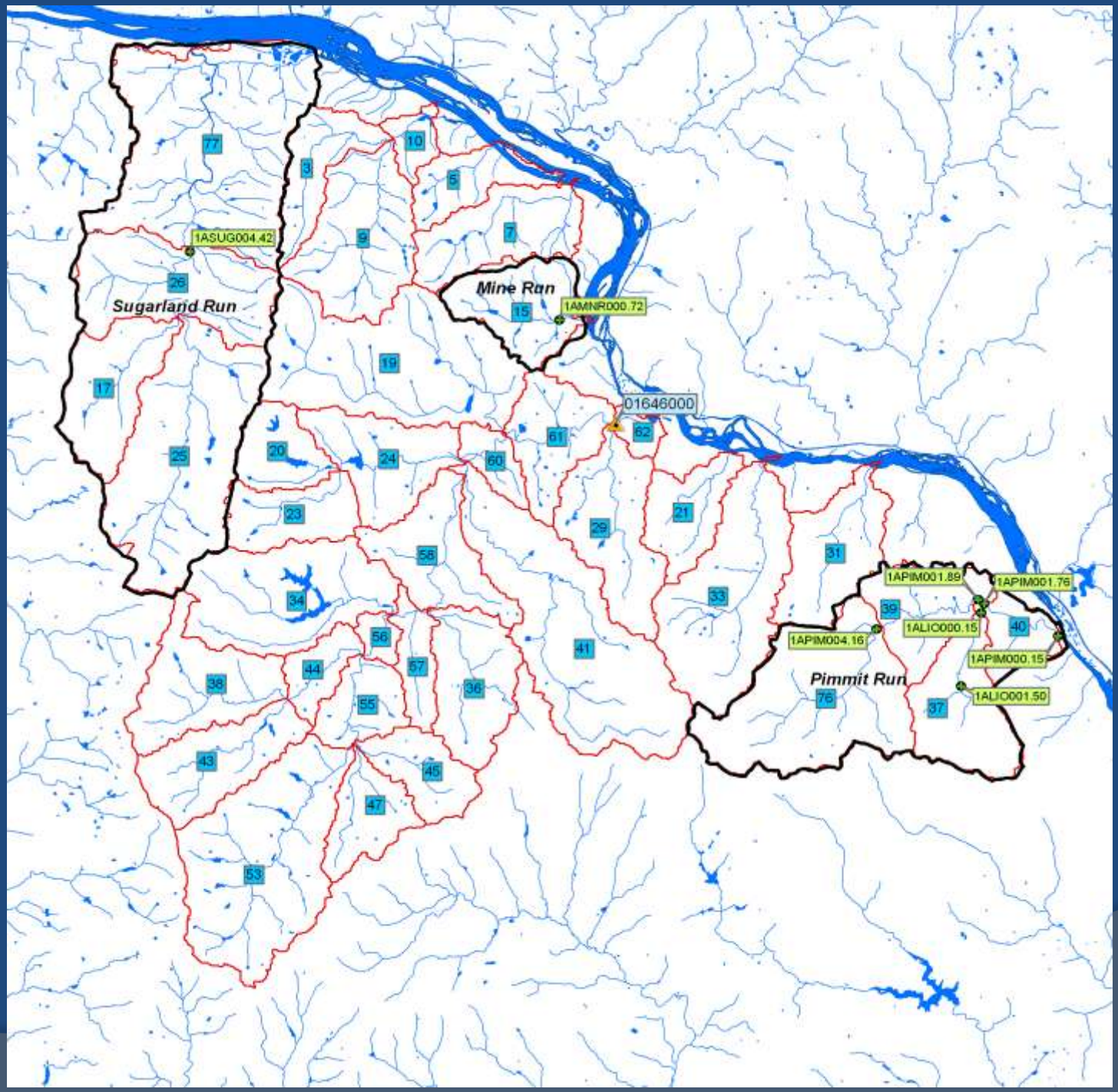
Fecal coliform die off rates



Watershed Response

HSPF Model Setup for Sugarland Run, Mine Run, and Pimmit Run

- Drainage area delineated to 38 model segments for bacteria loadings
- Hydrologic Model Calibration/Validation
  - USGS Flow Station 01646000 (Difficult Run)
- Water quality Model Calibration/Validation
  - Using DEQ water quality stations on impaired segment
- Weather data:
  - NCDC data from Dulles Airport



HSPF Modeling Segments and DEQ Monitoring Stations

MS4 Allocations

- Multiple MS4 permits in each watershed
- Approach for Assigning WLA for each permit:
  - Land Based Loads coming from urban land uses
  - Aggregated WLA by Geographical Areas

Sugarland Run (A10R-01-BAC)				
Permit Number	**MS4 Permit**	**MS4 Geographical Area**	**Wasteload Allocation (cfu/day)**	**Wasteload Allocation (cfu/year)**
VA0088587	Fairfax County	Fairfax County	TBD	TBD
VAR040104	Fairfax County Public Schools			
VAR040115	Virginia Department of Transportation			
VAR040067	Loudoun County	Loudoun County	TBD	TBD
VAR040115	Virginia Department of Transportation			
VAR040060	Town of Herndon	Town of Herndon	TBD	TBD
VAR040104	Fairfax County Public Schools			
VAR040115	Virginia Department of Transportation			
		Total WLA	**TBD**	**TBD**

Next Steps

Schedule for Project Completion

	January 2011	February 2011	March 2011	April 2011	May 2011	June 2011	July 2011	August 2011	September 2011	October 2011	November 2011	December 2011
Data Gathering	■	■	■	■								
Joint TAC Meeting			■									
First Round of Public Meetings				■								
Source Assessment				■	■	■	■	■				
Model Calibration and Validation									■	■		
Second Round of TAC Meetings									■			
Draft TMDL Allocations										■		
Third Round of TAC Meetings										■	■	
Draft TMDL Reports											■	
Final Round of Public Meetings											■	
Comment Period on Draft Report											■	■
Final Draft of Report Submitted to EPA for Approval												■

Comment Period

- **Comment Period for Materials Presented at the TAC Meeting extends from September 14, 2011 to October 14, 2011.**
- **Comments should be submitted in writing to:**

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  13901 Crown Court, Woodbridge, VA 22193

Questions?

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